

23-51-Q3

(a)(i) Q: vector-matrix form and scalar form input and output?

$$X = [x_1 \ x_2 \ x_3 \ \dots \ x_{100}]^T$$

$$y = [y_1 \ y_2 \ \dots \ y_{98}]^T$$

$$W = [w_{ij}] \quad 98 \times 100$$

$$\theta = [\theta_1 \ \theta_2 \ \dots \ \theta_{98}]^T$$

vector-matrix form

$$y = Wx + \theta$$

scalar form

$$y_i = \sum_{j=1}^{100} w_{ij} x_j + \theta_i \quad i = 1, 2, \dots, 98$$

(ii) Q parameters? multiplications? summations?

Solution

$$\text{parameters} : 98 \times 100 + 98 = 9898$$

$$\text{multiplications} : 98 \times 100 = 9800$$

$$\text{summations} : 98 \times (99+1) = 9800$$

(iii) Q: ratio

$$\text{Solution Ratio} = \frac{98}{9898} \approx 0.0099$$

$$y_i = \sum_{j=1}^{100} w_{ij} x_j + \theta_i$$

$$y_1 = w_{11}x_1 + w_{12}x_2 + \dots + \theta_1$$

Neural Networks and Deep CNN -- Neuron Model

In mathematical terms, we can describe the neuron as: 用数学术语，我们可以将神经元描述为：

$$u_k = \sum_{j=1}^p w_{kj} x_j \quad y_k = f(u_k - \theta_k)$$

Where x_1, x_2, \dots, x_p are the input signals, $w_{k1}, w_{k2}, \dots, w_{kp}$ are the synaptic weights of neuron k , u_k is the linear combiner output, θ_k is the **threshold**, $f(\cdot)$ is the activation function and y_k is the neurons output. 其中 x_1, x_2, \dots, x_p 是输入信号, $w_{k1}, w_{k2}, \dots, w_{kp}$ 是第 k 个神经元的突触权重, u_k 是线性组合输出, θ_k 是阈值, $f(\cdot)$ 是激活函数, y_k 是神经元的输出. θ_k is an external parameter, we can consider this parameter as an input variable: θ_k 是一个外部参数, 我们可以将这个参数看作一个输入变量.

Then we have: $x_0 = 1, \quad w_{k0} = -\theta_k$

第一题是+ 还是- ?

(a) Output after FC layer

$$= Wx + b$$

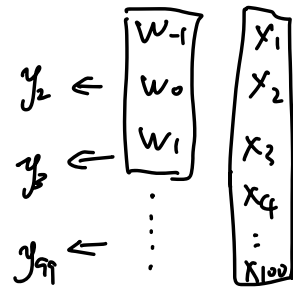
$$= \begin{bmatrix} 0 & 3 & 7 & 8 \\ 1 & 8 & 0 & 0 \\ 0 & 8 & 1 & 0 \end{bmatrix} \begin{bmatrix} 0.3 \\ 0 \\ 0.2 \\ 0.1 \end{bmatrix} + \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1.2 \\ 1.3 \\ 2.2 \end{bmatrix}$$

100 数加 99 次
加 1 次 θ

$$(b)(i) y_i^{(k)} = w_{-1}^{(k)} x_{i-1} + w_0^{(k)} x_i + w_1^{(k)} x_{i+1} + b^{(k)}$$

$$k = 1, 2, \dots, 20$$

$$i = 1, 2, \dots, 99$$



$$(ii) \text{ parameters: } 20 \times (3 + 1) = 80$$

$$\text{multiplications: } 3 \times 98 \times 20 = 5880$$

$$\text{summations: } (2 + 1) \times 98 \times 20 = 5880$$

$$(iii) \text{ Ratio} = \frac{98 \times 20}{80} = 24.5$$

20个(3权重 + 1个bias)

每个 y 乘 3 次, 98个 y
共 20个

每个 y 加 2 权加 1 偏
98个 y , 20个